Advanced Techniques in the Characterization of Electromagnetic Properties of Materials



Kenneth Dudley

NASA Langley Research Center

Electromagnetics Properties of Materials Lab

Introduction

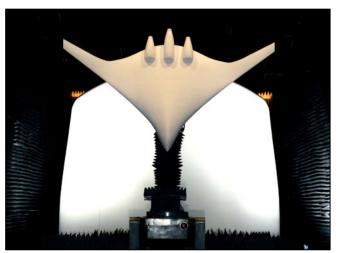
Materials design is still more a process of discovery than design. It is principally an investigation based upon known concepts and the acquired intuition of experimentalist. The conditions for successful designs of new materials do not rely on a particular technique, a unique experimental observation, or an abstruse theory to be proven or disproven. On the contrary, materials design efforts critically depend upon amassing large volumes of experimentally determined data that permit an individual with deep insight to perceive an underlying pattern not previously apparent.

--- Dr. Steven LeClair

US Air Force Research Laboratory

Aerospace Systems

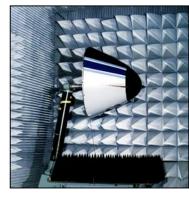
Hypersonic X-43



Blended Wing Body



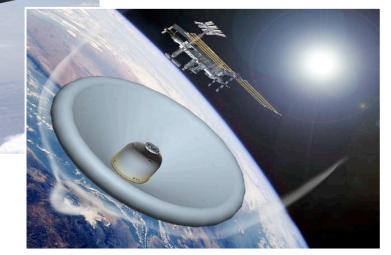
Aft Flow Ionization



Multi-Spectral Radome



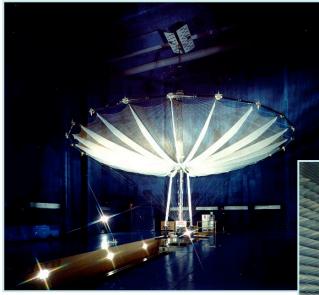
Advanced Helicopter



Aerobraking Ballute Re-entry

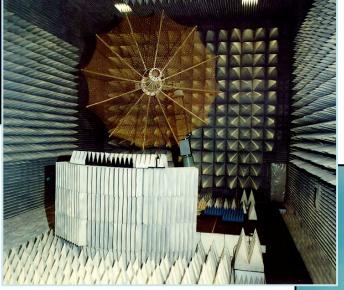
Antenna Systems



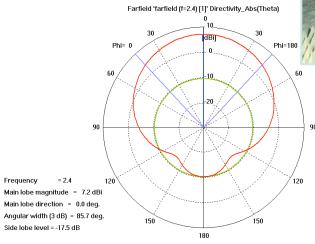


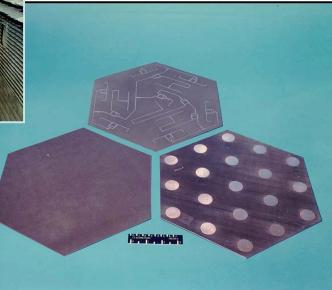
Mesh Antennas





Microstrip Antennas and Circuits





Inflatable Systems

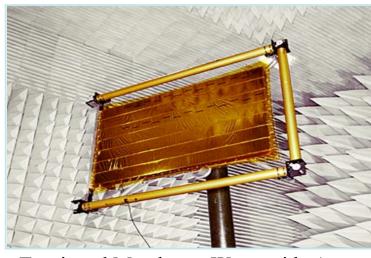




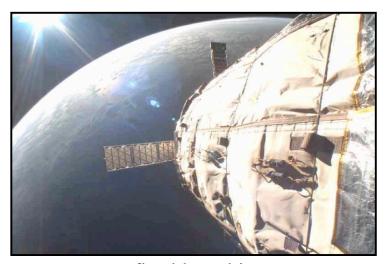
Sunshades



Inflatable Antennas and Structures



Tensioned Membrane Waveguide Array

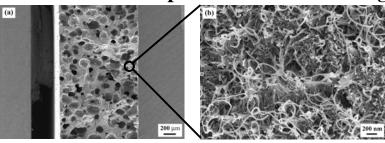


Inflatable Habitats

Nanotechnology



CNT – foam composites for EM shielding



Novel Carbon Nanotube-Polystyrene Foam Composites for Electromagnetic Interference Shielding

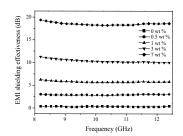
Nano Letters

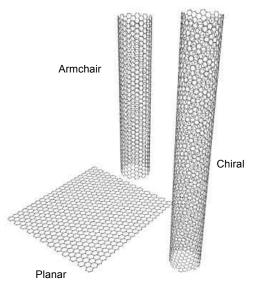
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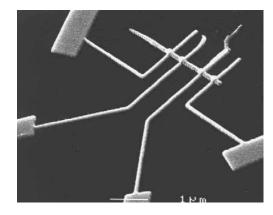


CNT Loaded Polymers

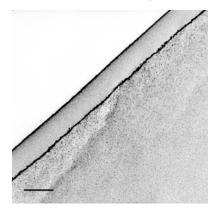
1 wt%

2 wt%

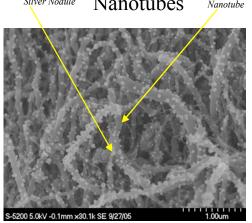
Microscale 4-Point Probe



Metallized Polymers



Decorated Carbon Nanotubes



5 wt%

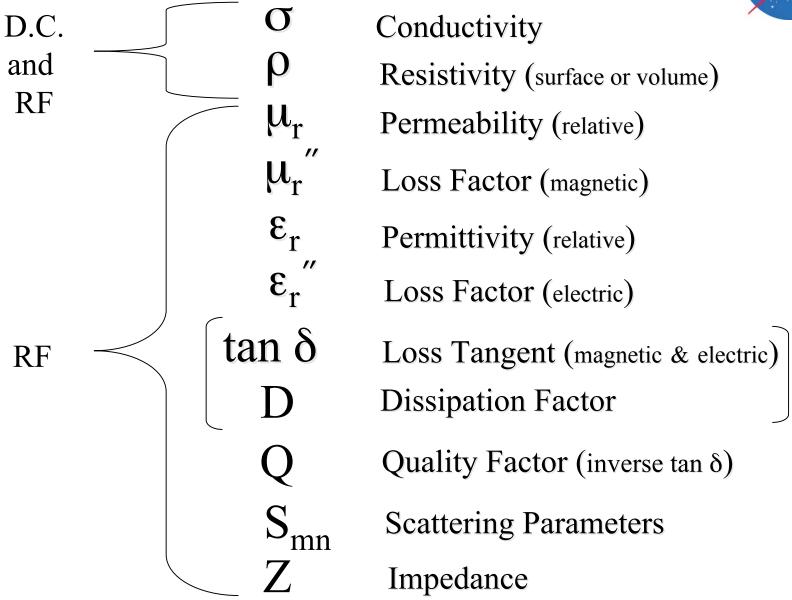
10 wt%

20 wt%

Nanotubes with 10% Ag

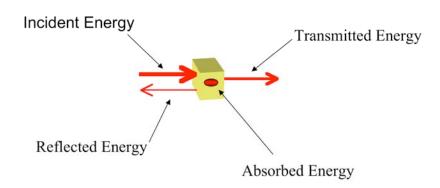
Electrical Properties





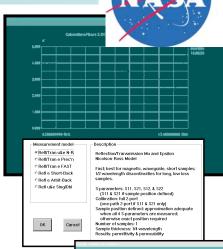
S-Parameters

Scattering Parameters





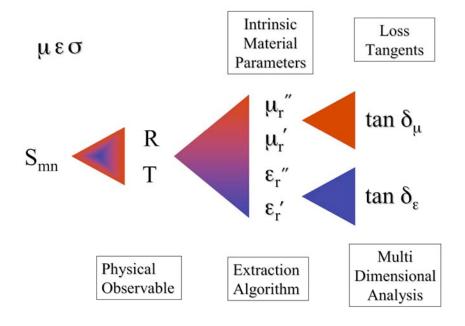


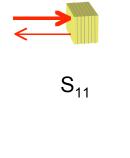


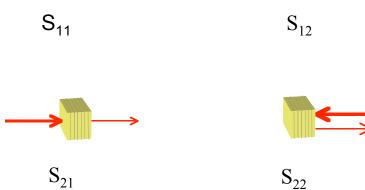


Parameter Extraction

 $\mu_r^{\ \prime} \ \mu_r^{\ \prime\prime}$

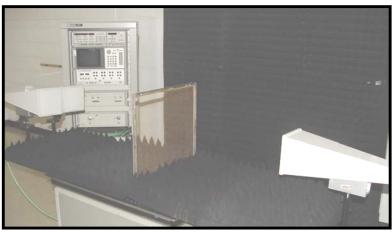




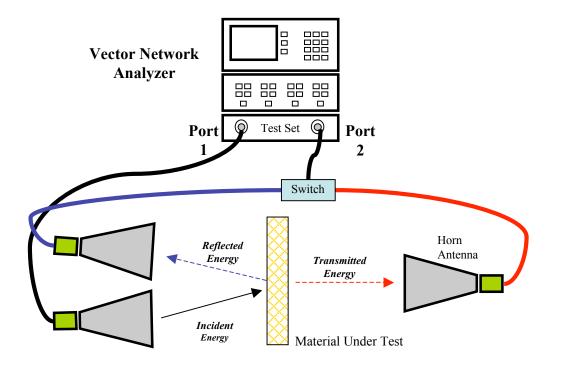


Measurement Methods





Free Space Method



Free Space

Transmission Line

Coaxial Probe

Four Point Probe

Resonant Cavities

Horn Probe

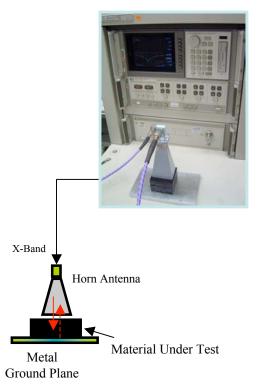
Resistivity Cell

Parallel Plate

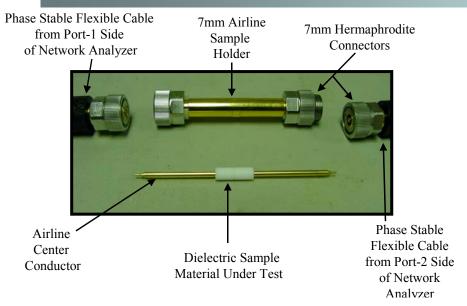
Focused Beam

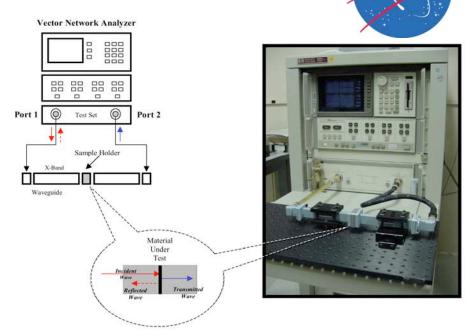
NRL Arch

RCS

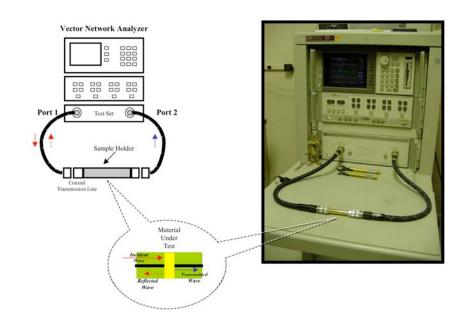


Measurement Methods

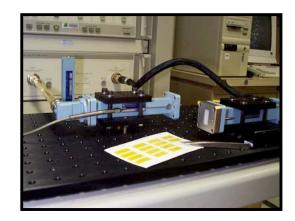




7mm Coaxial Transmission Line Method



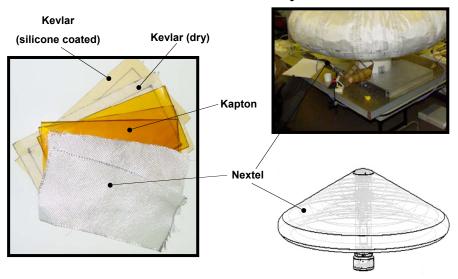
Waveguide Transmission Line Method



Aerospace Systems



IRVE Material System

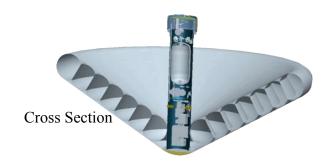




L-Band Waveguide Measurements

Aerobraking Ballute







Inflatable Re-entry Vehicle Experiment

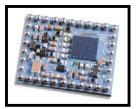
Applications





Aerospace

Materials



Antennas

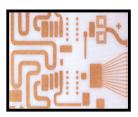
Electronics



RF MEMS
Telecommunications



Medical Biomedical Biotechnology



Remote Sensing Sensors

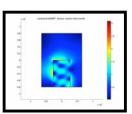


Composites

Polymers



Chemicals



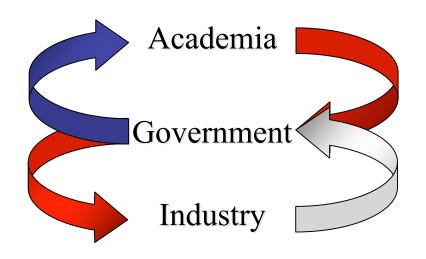
Computer Aided Design



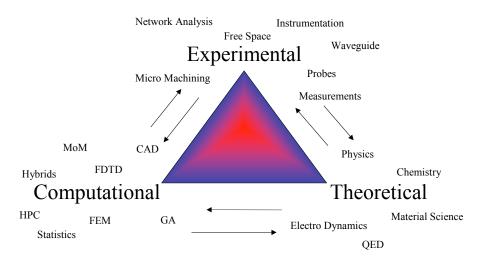
Petroleum, Oils, and Lubricants



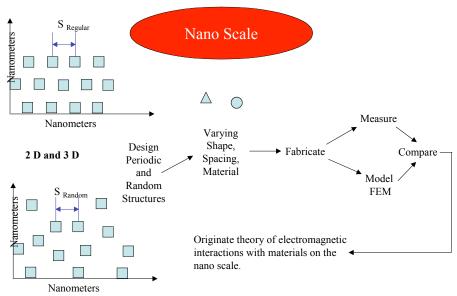
Collaboration and Partnership

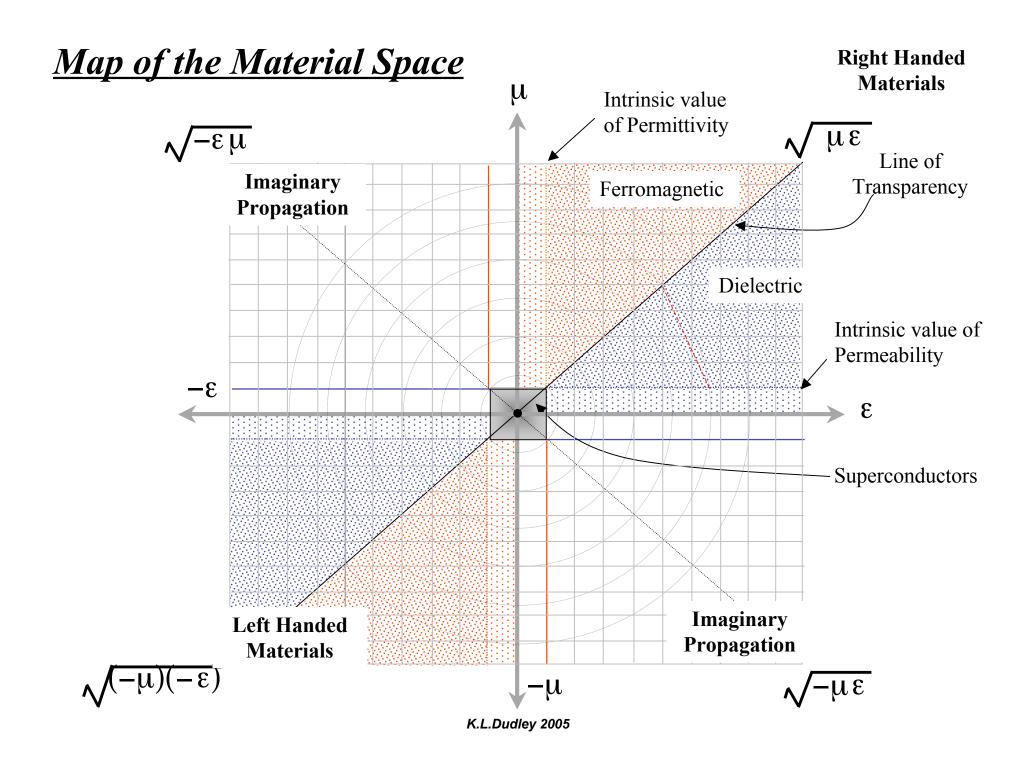


EM Material Design



EM Material Study





Contacts

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